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ENTOMOLOGICAL NEWS

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The Directional Sound Waves of Oecanthus Nigricornis Argentinus or A Violinist Listens to an Insect

MILLARD WILLIAMS, Santa Monica, California

The second title much more nearly fits the writer than does the scientific description set forth above it. But possession of a trained musical ear has led to an interesting discovery regarding the abilities of what I first considered as a quite ordinary cricket-like wing singer. And hence a violin teacher finds himself writing along a line about which he knows comparatively little, except for the discovery itself. The reader will therefore bear with a lack of scientific terminology, and I must also ask that my frequent use of the first person be pardoned.

Some fifteen years ago, while living in Pacific Palisades (a section of Los Angeles just north of my present home city of Santa Monica), I took frequent walks over the vacant lots of the then sparsely settled district. These walks were taken in the evenings and thus led to my becoming interested in the songs of various insects. It was found that one could approach these little creatures quite closely, if care was taken not to snap twigs or otherwise set up vibrations which they could perceive, and it was further noted that they did not object to the brilliant beam of a three cell focusing-model flashlight. Thus ground crickets were observed, together with grasshoppers and so forth. But one type of insect in particular drew my attention because of its high pitched continuous song which seemed to vary constantly

in volume as I moved about the bushes whereon they were perched. During the summer nights these insects sang with might and main, holding their wings straight up or even slightly forward of the vertical. The bright light did not bother them in the least which permitted close examination of very many of them.

As time went on the fact of the marked change in tonal intensity began to impress itself upon my attention, which led to my trying to find out what the cause of this might be. No apparent change seemed present in the wing motion, yet the tone volume increased and decreased constantly as I moved about watching any particular insect. Fortunately I did not credit these changes to the interference caused by stems or leaves of the bushes, particularly since they were in a kind of milk-weed with comparatively light foliage and rather delicate structure.

It occurred to me, one evening, to focus my light upon a certain insect while it was singing loudly but not moving on its perch, and then walk slowly about the bush and note what effect my motions would have on the tone volume. As I moved the tone became gradually less and less until it was almost inaudible, and then it began to increase until it reached its former volume, which was followed by another drop in loudness, and then a return to clear strong tone as I completed my circuit of the bush. I had taken great care to see that the insect had not moved the position of its body, and hence I felt sure that something connected with my own motions had brought about the marked change in tonal power of this wing singer. It was then only a matter of minutes before I found that if I stood either directly behind or before the line of the insect's body the tone would be loud and clear, but if I moved to either side it became less until it reached the least audible point in a line parallel with the plane of vibration of the wings. This effect I tested again and again with these insects, always finding the results the same.

Supposing that this fact of the peculiar ability of the little green cricket to send out highly directional sound waves perpendicular to the plane of its wings was well known to entomolo-

gists, I did nothing about the discovery for a number of years. But as the years continued to come and go it became apparent to me, particularly in reading the articles on insects published in the National Geographic Magazine, that no mention was made of this special sound effect. Then, after still more years had passed, I presented the matter to the National Geographic with a request that they place it in the hands of some one who would be in a position to check the data in order that the discovery, if such it actually was, might not go unrecorded. The magazine replied that it was forwarding my letter to Dr. Edward A. Chapin, Curator of the Division of Insects of the U. S. National Museum, and he wrote to me that he had not read any material wherein such a sound effect was discussed. He said that he wished to send my letter to Mr. James A. G. Rehn, Curator of the Department of Insects of the Academy of Natural Sciences of Philadelphia, and asked that I try to obtain a specimen of the insect in question and if possible repeat some of my observations of it.

Inspired by this request I went at once to the West Los Angeles Police Department! This appearing to be a quite necessary precaution for one preparing to become an admitted prowler after dark close to a section of the Pacific coast during war time. The Police read my letter from Dr. Chapin with much interest, and advised me to carry it with me, saying that if I did not try to run away I would probably not be shot, although they would have to send a patrol car for me if a call came in about my doings. Thus officially registered as an unofficial agent of the Smithsonian Institution in Washington, D. C., I drove over to Pacific Palisades and managed to locate some of the insects desired. It proved an easy matter to capture two of them, in spite of my rather unorthodox equipment consisting of a kitchen glass and a bit of cardboard, for both of the creatures elected to sit tight instead of hopping away as they can so easily do. I was able to re-check most carefully my observations of the sound wave—using it, in fact, to locate the insects since one needs only to find the point of greatest intensity and the singer will be seen in a light beam directed along

the sound wave line. The marked variation in tonal intensity was even more pronounced than I had previously considered it to be, for moving my ear a very few inches from the point of greatest loudness brought a noticeable drop in volume.

I was, of course, most pleased to have all the data, including the specimens, sent to Mr. Rehn for his consideration, and I wish to express my sincere appreciation of the most careful study he has given the matter. This article is written at his request, and I trust that he will add to it his findings concerning the insect under discussion.

It is indeed a pleasure to me to feel that *Oecanthus nigricornis argentinus*—a name which I shall always spell in underlined form with due reverence for its immensity in the ears of the layman—is to receive recognition as possibly the first creature to send out highly directional sound waves, even as the spider has long since established its reputation as the first aviator.

Notes on Some North American Hesperiidae, with Two New Records for the United States (Lepidoptera, Rhopalocera)

By H. A. Freeman, Pharr, Texas

Urbanus eurycles (Latreille)

Henry Skinner recorded this species for the United States in 1901,[1] and since that time no authentic records have been made. Some doubt has existed as to the correct determination of Skinners' record, however this can now be put aside as *eurycles* is well established in the lower Rio Grande Valley of Texas. Mr. T. M. Dunkle, Saratoga, California, sent the writer a ♀ specimen collected at Brownsville, Texas, July, 1943. The writer collected 6 ♂♂, V–26–44, at Brownsville and 1 ♀ at Pharr, Hidalgo County, Texas, VIII–24–44. A number of other specimens were observed at Brownsville during May, flying in company with *simplicius* (Stoll). *Eurycles,* however prefers the shade, whereas *simplicius* flies in the bright sunshine.

[1] Ent. News, XII, 171, 1901.

Astraptes fulgerator (Walsh)

W. D. Field recorded the capture of a specimen of this species at Donna, Texas.[2] The writer caught two ♂♂ at Brownsville, Texas, one V–26–44 and another VIII–29–44. While looking over a collection of Lepidoptera made by Mrs. E. J. Kelso, a number of both sexes of this species were found, all having been caught in her yard at Pharr, Texas. Apparently this species is established in the Lower Rio Grande Valley of Texas as a number of the specimens observed were fresh.

Astraptes anaphus (Cramer)

The writer caught a fresh, ♀ *anaphus* at Pharr, Texas, IX–9–44. As far as the writer knows this is the first record of this species having been caught in the United States. Although this species is said to be common in Mexico the writer caught only one ♂ during two summers of collecting from Nuevo Laredo to Acapulco, so apparently it is rather local in its habits.

Lerodea tyrtaeus (Ploetz)

Since recording the capture of a ♀ *tyrtaeus* at West Columbia, Texas,[3] the writer has collected seven more specimens of this species, two ♂♂ at Brownsville, Texas, V–25–44 and two ♀♀, VIII–29–44; one ♂ and one ♀ at Pharr, Texas, IX–10–44 and another ♀, IX–17–44. This species has become established in Texas as five of the specimens taken were freshly emerged. This species prefers to fly in the shade of the tropical undergrowth so abundant along the lower Rio Grande River.

Perichares phocion dolores (Reakirt)

Mrs. E. J. Kelso caught a fresh, ♂ specimen of this species in her yard at Pharr, Hidalgo County, Texas, during November, 1940. As far as the writer can ascertain this is the first record of this species or any of its races having been collected in the United States. Apparently this specimen strayed across the border from Mexico, where it is more common.

[2] Journal of the Kansas Entomological Society, Vol. 13, April 1940; No. 2.

[3] Field & Laboratory, Vol. IX, May, 1941, No. 2.

An Observation of Ants Killing a Larva of the Japanese Beetle

By Joseph L. Williams, Lincoln University, Pennsylvania

At Lincoln University in Chester County, Pennsylvania, a nest of ground ants was disturbed while hoeing in the garden during the latter part of May. A short period was spent observing the workers frantically carrying their larvae and pupae to a place of safety. Shortly afterwards hoeing was resumed. A short distance from the ants a Japanese beetle larva was unearthed without injury.

In a few minutes several ants began attacking the beetle larva about its head. Later other ants were attracted to this struggle, until finally the body of the larva was almost covered with ants. This fight, however, did not cause all of the ants to stop and join in the attack, for hundreds of them were still busy carrying off their larvae and pupae to a place of safety.

The larva did not take this attack quietly. It fought back grimly with great vigor. Many ants were killed by its powerful mandibles. The ants, however, kept on coming. They attacked most severely around the larva's head. Two other groups were attacking it on the thorax and at its extreme posterior end. The larva, now being attacked from all sides, gave up fighting and tried to escape by burrowing into the soil. The ants prevented the larva from burrowing by crowding in and inflicting such severe pain that it was forced to fight for its life.

The beetle larva finally lost its balance and fell over on its back. It tried desperately to right its body. The ants prevented this by some piling small particles of dirt around the body. These particles formed a groove throughout the length of the larva's body. During this operation the other ants continued biting the larva.

Having the larva badly injured, the ants crowded in for the kill. The larva became so weak that it was unable to fight the ants. Movement of the beetle's body became weak and spasmodic, and finally ceased.

This struggle began at 11:45 A.M. and the larva was completely paralyzed or dead by 1:20 P.M. After the fight ended the ants began covering the larva's body with fine soil. This operation was observed until the body was half covered with soil. At this point the larva and specimens of the ants were collected and sent to the United States Museum for identification.

The larva was confirmed as that of the Japanese beetle (*Popillia japonica* Newn.). The ants were identified as *Tetramorium caespitum* L. The author is grateful to the officials of the Museum for this kindness.

An examination of the larva under the dissecting microscope revealed deep wounds just behind the head and on the thorax just above the legs. The femoral part of each leg on the right side had deep cavities eaten into it. The exoskeleton did not appear broken over the remainder of the body.

Midwinter Collecting of Lepidoptera in Michigan

JOHN H. NEWMAN, Detroit, Michigan

A strip of woods which extends for about two miles, from a short distance north of the town of Utica, Macomb County, Michigan (about twelve miles north of the city limits of Detroit) has yielded interesting and rare specimens of many kinds of insects. Owing to the proximity of the locality to the writer's home he has been able to collect moths there in every month of the year and presents the following notes on captures in January, February and early March in the hope that they might add in a small way to our knowledge of the habits and distribution of these moths and that they might interest other collectors. November and December captures are much more plentiful and the author has numerous species collected in these months which complete recorded captures for each month of the year. It has been my experience when seeking off-season or midwinter specimens one must, it seems, forget the calendar and pay more attention to the thermometer. The locality, known

to old residents as the Devil's Hole, is a mixed hardwoods composed chiefly of oak, hickory, maple and elm with rather heavy concentrations of poplar and some basswood. The ground vegetation is luxuriant owing to the low humid situation. Hygrometer readings have always been at least 58%. The first attempt at winter collecting was on March 7, 1942, when the temperature rose to 54 degrees. In one and one-half hours collecting the following specimens were taken, at bait 1, *Graptolitha antennata;* 4, *Conistra morrisoni;* at light 38, *Homoglaea hircina.* The latter were interesting as no more than 3 or 4 had been taken in Michigan previously.

The second opportunity was offered on February 22, 1943, when the temperature rose to 57 degrees. That evening in the company of Mr. Sherman Moore the sugaring technique of more normal collecting nights was tried, but in vain. However on draping a light sheet over a bush 4 specimens of *Homoglaea hircina* were secured, although by this time the temperature had receded to 30 degrees and the ground and grass tufts crackled with ice crystals underfoot. One specimen of *Conistra morrisoni* was also taken off a small sapling apparently feeding on a moist exudate. We collected a little more than an hour.

The following night, February 23, 1943, was warmer; in the woods at 9:00 p.m. the temperature was 46 degrees, the humidity 60%, and in sharp contrast to the preceding night the sugar-beer bait was alive with moths, most trees attracting 18 to 24 specimens. By nine o'clock I had collected 63 examples and could easily have taken at least 150, although additional material would have been repetition. I collected about one and one-half hours until a steady rain began soon after nine o'clock. The evening's catch was determined as follows. At bait: 24, *Conistra morrisoni;* 26, *Conistra sidus;* 1, *Graptolitha bethunei;* 2, *Graptolitha laticinera;* 2, *Graptolitha antennata.* At light: 7, *Homoglaea hircina;* 1, *Xylena curvimacula.* The next day the temperature dropped to 34 and during the night it registered 12 degrees.

On January 25, 1944, the temperature rose to 61 degrees, a record of at least 71 years. Since the weather had been mild

for some days previous I considered it a good time to see what could be collected in January. At 6:50 p.m. the first moth was taken at bait and at 8 o'clock after having taken 12 specimens the show seemed to be over, for the last two trips along the bait-line yielded nothing at all. The material collected was: 4, *Conistra morrisoni;* 5, *Conistra sidus;* 1, *Conistra indirecta;* 1, *Pyreferra graefiana;* 1, *Peronia ferrugana.* All were in excellent condition, fresh in color and wing fringes unimpaired. The following day, January 26, 1944, gave another temperature record, 64 degrees. I set my bait rather early and by 7:50 p.m., when things called a halt rather suddenly I had taken another 13 specimens. A light-sheet draped over a bush yielded nothing, *Homoglaea hircina* being conspicuous by its absence. The material collected was as follows. 4, *Conistra indirecta;* 5, *Conistra morrisoni;* 2, *Pyreferra graefiana;* 1, *Agnopteryx nigrinotella;* 1, *Agnopteryx pulvipennella.*

The collections may be tabulated as follows.

Phalaenidae Cuculliinae:

Conistra indirecta Wlk.—1, Jan. 25 and 4, Jan. 26, 1944.
C. morrisoni Grt.—4, Mar. 7, 1942; 1, Feb. 22 and 24, Feb. 23.
C. sidus Gn.—26, Feb. 23, 1943; 5, Jan. 26, 1944.
Pyreferra graefiana Grt.—1, Jan. 25, and 2, Jan. 26, 1944.
Graptolitha antennata Wlk.—1, Mar. 7, 1942; 2, Feb. 23, 1943.
G. bethunei G. and R.—1, Feb. 23, 1943.
G. laticinera Grt.—2, Feb. 23, 1943.
Homoglaea hircina Morr.—38, Mar. 7, 1942; 4, Feb. 22 and 7, Feb. 23, 1943.
Xylena curvimacula Morr.—1, Feb. 23, 1943.

Oecophoridae (det. Sherman Moore):

Agnopteryx nigrinotella Busck—1, Jan. 26, 1944.
A. pulvipennella Clem.—1, Jan. 26, 1944.

Tortricidae (det. Sherman Moore):

Peronea ferrugana Schiff.—1, Jan. 25, 1944.

Notes on Fleas (Siphonaptera) in Nebraska * †

By Doris B. Gates, Nebraska Agricultural Experiment Station

In view of the fact that increased attention is being given various parasites, particularly their connection with diseases (endemic and introduced) it seems desirable to publish a list of the Nebraska fleas now in the collection maintained by the University of Nebraska Department of Entomology. Since relatively little work has been done on ectoparasites in Nebraska, this list may be only a small percentage of the species present in the state. Towns are Nebraska towns; names of collectors are in parentheses.

Cediopsylla (*Acediopsylla*) *inaequalis inaequalis* (Baker) 1895. On *Sylvilagus auduboni baileyi* (Merriam), Harrisburg, May 7, 1942 (3 ♀♀, 2 ♂♂) (H. J. Martley). On *Cynomys ludovicianus ludovicianus* (Ord), Crawford, June, 1944 (♀) (H. J. Martley). On *Lepus townsendii campanius* Hollister, Crawford, June, 1944 (♂) (H. J. Martley). On *Sylvilagus* sp., Chadron, July 15, 1944 (5 ♀♀–3 ♂♂); Hay Springs, July 17, 1944 (4 ♀♀–2 ♂♂) (D. Gates). On *Sylvilagus floridanus similis* Nelson, Chadron, July 29, 1944 (♂) (H. J. Martley). Reported from Nebraska by Jellison (1940).

Cediopsylla (*Cediopsylla*) *simplex* (Baker) 1895. On rabbit, Roca, Oct. 31, 1915 (♀) (G. H. Kohls). On *Lepus townsendii campanius* Hollister, Lincoln, June 2, 1944, (♀) (D. Gates).

Ctenocephalides canis (Curtis) 1826; *Ctenocephalides felis* (Bouché) 1835.

Most specimens exhibit short rounded heads as in *C. canis*

* Keys by Fox (1940) and Ewing and Fox (1943) were followed in most determinations. These were supplemented by Baker's key (1904); for fleas from prairie dogs, Jellison's publication (1939), and for fleas from rabbits, Jellison's bulletin (1940) were used. Anthony's Field Book of North American Mammals (1928) was used for host identfiication.

† Published with the approval of the Director as Paper No. 356, Journal Series, Nebraska Agricultural Experiment Station.

and nearly equal ctenidial spines I and II as in *C. felis,* possibly indicating hybridization.

On cat, Lincoln, Nov. 16, 1895 (4 ♀♀, 2 ♂♂) (Coll. ?). On dog, Lincoln, July 24, 1890 (3 ♀♀, 3 ♂♂) (L. Bruner), May 2, 1944 (♂) (D. Gates). In house, Deweese, June 26, 1943 (♀, ♂) (Mary Homolka); Lincoln, June 26, 1942 (6 ♀♀, 16 ♂♂) (H. D. Tate). In basement of house, Beatrice, Aug. 7, 1943 (8 ♀♀) (Coll. ?). In house, Lincoln, June 11, 1944 (18 ♀♀, 3 ♂♂) (D. Gates); June 15, 1944 (8 ♀♀) (D. B. Whelan). On dog, Lincoln, June 23, 1944 (♀) (D. Gates); Geneva, June 28, 1944 (2 ♀♀, 1 ♂); Lincoln, August 7, 1944 (8 ♀♀) (Coll. ?).

Ctenophthalmus pseudagyrtes Baker 1904. On *Microtus pennsylvanicus* subsp., Lincoln, Febr. 9, 1944 (3 ♀♀, 7 ♂♂) (D. Gates). On mole, Lincoln, Sept. 27, 1901 (5 ♀♀, 5 ♂♂) (Coll. ?); May 30, 1894 (3 ♀♀, 2 ♂♂) (L. Bruner); Oct. 11, 1915 (♀) (Coll. ?); Date ? (4 ♀♀, 1 ♂). On *Rattus norvegicus* (Erxleben), Lincoln, Mar. 30, 1944 (♀) (D. Gates). On *Scalopus aquaticus machrinoides* Jackson, Lincoln, July, 1921 (♀) (M. H. Swenk); Dec. 30, 1943 (6 ♀♀, 1 ♂); Louisville, Dec. 2, 1943 (9 ♀♀, 6 ♂♂) (D. Gates); Hendley, Sept. 18, 1944 (2 ♀♀, 1 ♂) (L. M. Gates). Previously reported by Baker (1895) as *Typhlopsylla assimilis.*

Dactylopsylla (*Foxella*) *ignota ignota* (Baker) 1895. On *Geomys bursarius* (Shaw), Schuyler, May 8, 1943 (7 ♀♀, 2 ♂♂); Blair, March 8, 1943 (♀, ♂) Herman, March 8, 1943 (♀, ♂) (H. D. Tate). On *Geomys lutescens* (Merriam), Crawford, Sept. 26, 1943 (2 ♀♀, 1 ♂) (H. J. Martley). On pocket gopher, Lincoln, Oct. 22, 1931 (3 ♀♀, 1 ♂) (Coll. ?).

Hoplopsyllus (*Euhoplopsyllus*) *affinis* (Baker) 1904. On rabbit, Roca, Oct. 31, 1915 (♀) (G. H. Kohls). On *Sylvilagus floridanus mearnsi* (Allen), Lincoln, March 27, 1944 (5 ♀♀, 1 ♂); April 25, 1944 (2 ♀♀, 2 ♂♂); Union, May 7, 1944 (♀) (D. Gates). On *Lepus townsendii campanius* Hollister, Huntley, August 8, 1944 (1 ♀, 2 ♂♂) (D. Gates). Reported from Nebraska by Jellison (1940).

Nearctopsylla genalis genalis (Baker) 1904. On *Scalopus aquaticus machrinoides* Jackson, Louisville, Dec. 2, 1943 (2 ♀♀, 2 ♂♂) (D. Gates).

Nosopsylla fasciatus (Bosc) 1801. Questionably recorded on rat by Swingle (1911).

Orchopeas howardii (Baker) 1895. On fox squirrel, Lincoln, Jan. 19, 1901 (3 ♀♀) (M. A. Carriker, Jr.); Dec. 1, 1890 (3 ♀♀, 1 ♂); Nov. 28, 1890 (♀) (L. Bruner). From cage of *Didelphis virginiana virginiana* Kerr, May 12, 1944 (10 ♀♀, 9 ♂♂) (D. Gates). On *Sylvilagus floridanus mearnsi* (Allen), Malcolm, April 25, 1944 (♀) (D. Gates). Described by Baker (1895) from specimens collected in Nebraska.

Orchopeas leucopus (Baker) 1904. On field mouse nest, Lincoln, April 11, 1889 (♀) (L. Bruner). On meadow mouse, Lincoln, March 4, 1893 (♂) (L. Bruner). On *Microtus pennsylvanicus* subsp., Lincoln, Aug. 25, 1942 (2 ♀♀, 1 ♂) (D. B. Whelan); Febr. 9, 1944 (3 ♀♀, 2 ♂♂); Febr. 10, 1944 (3 ♀♀, 3 ♂♂); March 4, 1944 (14 ♀♀, 6 ♂♂); March 21, 1944 (1 ♀, 2 ♀♀); Union, May 7, 1944 (3 ♀♀) (D. Gates). On *Mus musculus musculus* Linnaeus, Lincoln, March 21, 1944 (♀) (D. Gates). On *Peromyscus* sp., Lincoln, Febr. 8, 1944 (2 ♀♀); Febr. 28, 1944 (1 ♀, 5 ♂♂); March 11, 1944 (1 ♀, 2 ♂♂); March 23, 1944 (4 ♀♀, 2 ♂♂) (D. Gates).

Oropsylla (*Opisocrostis*) *bruneri* (Baker) 1895 (Marked "type"). On *Citellus franklini* (Sabine), Lincoln, Sept. 30, 1890 (♀) (L. Bruner). Described by Baker (1895) from specimens collected in Nebraska.

Oropsylla (*Opisocrostis*) *hirsuta* (Baker) 1895. On *Cynomys ludovicianus ludovicianus* (Ord), Harrisburg, May 12, 1942 (2 ♀♀, 2 ♂♂) (H. J. Martley); South central Cherry County, Oct. 16, 1943 (2 ♀♀, 2 ♂♂); Oct. 17, 1943 (15 ♂♂) (D. Gates); Chadron, July 15, 1944 (7 ♀♀, 5 ♂♂); Huntley, August 29, 1944 (2 ♀♀, 4 ♂♂) (D. Gates). On *Lepus townsendii campanius* Hollister, Huntley, August 29, 1944 (♂) (D. Gates).

Oropsylla (*Oropsylla*) sp. On *Callospermophilus* sp. Chadron, July 15, 1944 (♀) (D. Gates). On chipmunk, Chadron, July 15, 1944 (♀) (D. Gates).

Pulex irritans irritans Linnaeus 1758. House, Schuyler, Date ? (1 ♀, 2 ♂♂) (G. M. Byrne); Stromsburg, March 22, 1933 (2 ♂♂) (A. Lind). On *Canis nebracensis nebracensis* Merriam, Belmont, June 9, 1943 (2 ♀♀); Crawford, April 23, 1943 (2 ♀♀, 2 ♂♂) (H. J. Martley); 4–O Ranch, South central Cherry County, Nov. 17, 1943 (♀, ♂) (E. P. Ericksen); Hay Springs, June, 1944, (3 ♀♀) (H. J. Martley). Previously reported by Trembley and Bishopp (1940).

Xenophylla cheopis (Rothschild) 1903. On *Rattus norvegicus* (Erxleben), Lincoln, Dec. 28, 1943 (♂, ♀); Hastings, May 13, 1944 (4 ♀♀) (D. Gates). Reported by Gates (1944); questionably recorded by Swingle (1911).

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Taxonomic Categories and Population Genetics

By Alfred E. Emerson, Department of Zoology,
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Species constitute the primary taxonomic units and many definitions have been suggested. A species is an evolved or evolving, genetically distinctive, reproductively isolated, natural population. All these criteria are necessary and no others would seem to be essential.

Species are dynamic entities rather than static, so evolutionary characterization is necessary in a definition. Demarcation is sometimes arbitrary when transitional stages are encountered, but true evolutionary gradations between living sexual species are not very common because most ancient continuities have become discontinuous at present.

Genetic distinction would seem to be the common denominator for all valid qualitative or quantitative species characters including cytological, physiological, ecological, embryological, behavioristic and morphological characters. Taxonomists, of course, can seldom experimentally investigate the genetics of their material. However, heredity may be inferred through germinal continuity in populations and the genetic basis of similar characters in investigated organisms. The taxonomist also often observes hybrids and intergrading populations which give some genetic information.

Reproductive isolation may result from psychological, physiological, genetic, chronological, spatial, geographical or ecological separation, or from selection pressure against intermediates and hybrids. The essential point is the lack of chromosome or gene exchange. If no genetic distinction differentiates isolated populations they are treated as a single species as in the case of the Pacific coast and Appalachian populations of the roach, *Cryptocercus punctulatus* Scudder.

Finally, the species is a population. Different populations may differ in their genes or chromosomes or in percentage incidence of genes or gene arrangements. Wright (Huxley,

1940, p. 164) has stated that the elementary evolutionary process is change of gene frequency rather than mutation. Populations always have characteristic geographical patterns, but geography need not be incorporated separately in the definition. Taxonomists have quite consistently used the individual as a sample of a population which shares basic genetic characteristics. Populations have real biological attributes which are not merely the statistical summation of the individuals, just as individual organisms have properties which transcend the cellular units of which they are composed.

Groups of genetically related species constitute higher categories with separation based largely on extinction of intermediate species or groups of species. If all related species have become extinct leaving a single survivor, monotypic higher categories are recognized. Thus *Mastotermes darwiniensis* Froggatt is the sole surviving species of termite in the genus and the only living genus in the family Mastotermitidae.

Taxonomic subdivisions of the species are based upon genetic distinction of the natural populations and partial reproductive isolation. Often intermediate populations are found on the geographical or ecological borders of subspecies. On islands, occasional sharing of hereditary characteristics through interbreeding with stray individuals may result in subspecific status even though the borders of the populations are sharp. Ecological populations with genetic distinctions and partial reproductive isolation are called *ecotypes* (Turesson, 1922) and are in reality ecological subspecies or races.

Local populations with genetic characteristics are often given a status below the rank of subspecies. There is no established basis for the separation of subspecies and races. If genetic differences follow uniform gradients from one population to another, delimitation is arbitrary. If the gradients are not uniform or are discontinuous, delimitation is not arbitrary. Huxley (1939) has introduced the term *cline* for quantitative variations connecting populations and *stepped clines* within a species may indicate the genetic connections between subspecies or

races. Dobzhansky and Epling (1944) distinguish a multitude of chromosomal races of *Drosophila pseudoobscura* Frolova with adequate geographical rather than Latin names.

Taxonomists commonly use morphological characters for distinguishing various taxonomic categories. Morphology is the visible result of complex physiological effects upon patterns of growth. Probably structures are the end effects of long series of enzyme chain reactions on protoplasmic substrates. Physiological effects upon the morphological characters used by the vast majority of taxonomists are initiated by genes or chromosomal arrangements. Genes may be thought of as autocatalytic enzymes which may activate or inhibit the development of other enzymes. Taxonomic characters are commonly the result of the action of many genes (multiple factor or polygenic characters). Such characters may be detected by intermediates in the first hybrid generation and a wide quantitative variation rather than simple segregation in the second hybrid generation. Of course the genetic units would exhibit Mendelian segregation, but the interaction of many units is likely to show apparent blending of characters. Very rarely taxonomic characters exhibit simple Mendelian ratios in the second hybrid generation.

Forms and varieties caused by environmental factors and not by genetic differences have often received mistaken taxonomic recognition. The term *ecophene* seems adequate for such forms (Turesson, 1922). The capacity of an organism to react to the enviroment may have a genetic basis, but if hereditary constitution is not the cause of the difference, then taxonomic distinction is not valid.

Many authorities do not include asexual, parthenogenetic, self-fertilizing or closely inbreeding populations in the species concept. Populations of similar genotypes could still be regarded as species according to my definition. However, if slight genetic modifications result in distinctive populations, we are faced with an array of reproductively isolated *strains* such as occur among the bacteria and species nomenclature presents many difficulties.

With this background of principles, let us attempt to analyze particular cases. Valentine (1932) has separated subspecies of cave beetles (*Pseudanophthalmus*) from isolated caves. Because of the indicated reproductive isolation, such named subspecies should be placed in species categories. The so-called races A and B of *Drosophila pseudoobscura* Frolova are quite surely reproductively isolated in nature. Adequate morphological differences are not sufficient for determination of pinned specimens. However, the salivary gland chromosomes indicate considerable genetic distinction between the populations. Dobzhansky and Epling (1944) have described race B as a new species, *Drosophila persimilis*. Such a taxonomic assignment seems thoroughly justified. Bates (1940) has, in conformity to the foregoing principles, raised morphologically close populations of mosquitoes to species status which were formerly incorrectly included under *Anopheles maculipennis*. These populations are reproductively isolated and have genetic distinctions exhibited in the color pattern of the egg floats and in other slight characters of the larvae and adults. Fulton (1933) refers to "subspecies" of the cricket *Nemobius fasciatus* which can be distinguished by slight morphological characters, color, call, and habitat. Although his experiments show that these "subspecies" may interbreed in the laboratory, there seems to be no indication of interbreeding in nature. In spite of the small and often quantitative distinctions, these so-called subspecies are best classified as species. Holmgren (1913) described some striking termite soldiers from the oriental region and assigned them to a new genus and species, *Gnathotermes Aurivillii*. Kemner (1925) showed that these modified soldiers were parasitized individuals from colonies of *Macrotermes malaccensis* (Haviland) and correctly relegated Holmgren's genus and species to synonymy in spite of the great morphological differences. I have separated two species of termites, *Nasutitermes guayanae* (Holmgren) and *N. similis* Emerson (1935), on the basis of different species of termitophilous beetles living in the nests and overlapping quantitative mor-

phological characters. Dwarf soldiers from incipient colonies and intercastes between soldiers and workers show greater size and morphological differentiation within a species than the taxonomic distinction between the species, but great non-heritable differences have no taxonomic implication while slight heritable differences may. Polymorphic, seasonal, or migratory forms without genetic and population distinction within the same species of termite, ant, butterfly, aphid, grasshopper, or Army Worm do not deserve taxonomic status.

Domestic varieties or mutations in laboratory stocks are not natural populations. They may be referred to under the taxonomic name of the *coenospecies* which Turesson (1922) defined as the sumtotal of possible combinations in a genotype compound as seen particularly through cultivation under artificial conditions.

Although taxonomic names should not be given to non-taxonomic forms, such forms may be discovered by taxonomists and often have biological importance (Faure, 1932, 1943). Inasmuch as Latin names have been firmly established for taxonomic categories and are governed by international rules of nomenclature, confusion may be avoided by the use of other nomenclatural systems for non-taxonomic categories.

In a great many cases the data are insufficient to make more than a tentative guess concerning the genetics, reproductive isolation, or population characteristics of a given specimen or specimens. In such instances, one is justified in giving a name on the basis of a working hypothesis until further information is gathered. The tentative taxonomic assignment may subsequently be either reaffirmed, raised to higher rank, placed in a lower category, or relegated to synonymy. The accepted rules of nomenclature quite adequately facilitate such changes without breaking bibliographical continuity. All sciences propose working hypotheses which with increasing information may later become untenable. Taxonomy advances through the same methodology.

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Harrison Garman

Harrison Garman, State Entomologist and Botanist of Kentucky from 1889 to 1929, died at Lexington, in that State, August 7, 1944, after an illness of six years, aged nearly eighty-eight. His name originally was William Harrison Garman, but the William was dropped about 1881. He was born at Lena, Illinois, December 27, 1856, son of Benjamin and Sarah A. (Griffith) Garman. Later the family moved to Normal,

Illinois, where he attended the State Normal School and came in contact with Stephen A. Forbes and his associates. In 1881–82 he was at Johns Hopkins University under Prof. W. K. Brooks, whence he and B. P. Colton published his first paper, on the development of a sea-urchin, *Arbacia punctulata* (1882).

In 1883 he became assistant entomologist to Forbes and remained in Illinois until 1889. Results of his activity here, partly as Associate Professor of Zoology at the University, were papers on injurious insects, the anatomy and histology of a new earthworm (1888), animals of the Mississippi bottoms near Quincy (1889), Illinois reptiles and amphibians (1890, 1892) and the mouth-parts of Thysanoptera (1890).

In 1889 began his official services in Kentucky noted in the first sentence above, added to which, in 1912, was the professorship of entomology and zoology at the University of Kentucky. In the annual reports, bulletins, circulars and newspaper bulletins of the Kentucky Agricultural Experiment Station are 106 papers by Garman, of which 51 deal with entomology, 39 with botany, 9 with entomology and botany, 3 with entomology and other zoology, 2 with other zoology, 1 with botany and zoology, 1 with horticulture; these chiefly on the economic side. In the same period he published elsewhere not fewer than 47 papers (26 entomology, 8 botany, 1 entomology and botany, 10 other zoology, 2 horticulture). This group of entomological papers deals with insects from Kentucky caves (1891, 1892, 1893, 1894), life histories of two species of Coleoptera (1891), a gland of the cave cricket, *Hadenoecus subterraneus* (1893), the head and mouth-parts of Thysanoptera (1896), cited by Sharp (Cambridge Nat. Hist. vi: 528, 1899) and by Imms (Textbook of Entom., 1st edit.; 323, 327, 1924), the setae of lepidopterous larvae (1921) and Odonata of Kentucky (1924), as well as some on economic topics. His other zoological contributions treated of vertebrates (1894), crustaceans (1924) and fresh-water medusae (1916, 1922, 1924) of Kentucky, and the brain and pineal structures of the paddle-fish, *Polyodon folium* (1896).

Subsequent to his retirement in 1929, he published two papers: on the odonate *Archilestes* in Kentucky (1932) and on collecting insects in a sink hole cave (1937). He was the first to find *Archilestes* in the south-eastern States, both imago and larva. The Archilestes paper and that of 1924 on Odonata of Kentucky appeared in Entomological News.

He married Rosalie Miller, of Hatfield, Massachusetts, in 1883, and is survived by two sons, Frederick, of Juniata, Pennsylvania, and Philip, of Hamden, Connecticut, the latter likewise known for work in entomology. An older brother of Harrison Garman was Samuel Garman (1843–1927), a special pupil of Louis Agassiz and long assistant in herpetology and ichthyology at the Museum of Comparative Zoology, Harvard College.

Miss Mary L. Didlake, associate entomologist and botanist of the Kentucky Agricultural Experiment Station, has kindly furnished the following appreciation.

"Dr. Harrison Garman was out-standing as an entomologist, not a specialist in any one group, but having a surprisingly full knowledge of many. He was also an old-fashioned naturalist, studying life in all forms and in all relationships, knew wild flowers and trees, bacteria, fungi, protozoa, crustacea, fishes, frogs, snakes and birds as well as insects. His scientific work, as published in numerous bulletins and articles in journals, is widely recognized as conscientious and accurate.

"He was a good teacher, holding the interest and the respect of his students, rather strict and sparing of praise, his most enthusiastic commendation being, 'Well that's not so bad.'

"For many years, as State Entomologist, he personally inspected nurseries, gaining first-hand knowledge of the flora and fauna and of the occurrence of insect pest and fungous diseases and adding specimens to the herbarium and insect collection. Roads were bad in remote districts, but he was untiring in his zeal and always as careful in the expenditure of State funds as of his own."

PHILIP P. CALVERT

A Word from a Famous Collector, Orazio Querci

I have just recently received from the Academy a letter from which I quote:

"We always remember the valuable help which we had from you, and the proof of great confidence when you gave me the keys to your wonderful library, which we kept for two years. Amongst these books I had the happiest days of my life, and considerably increased my knowledge.

"I received your last letters from Greece; after the situation of the world had become chaotic.

"My wife is still an indefatigable collector. My daughter (Erilda Romei) went with her husband to Somaliland to study the insect life in an equatorial zone. She has returned and is now an interpreter in an Allied Command. It is now one year since we have heard from Dr. Romei who remained in Africa.

"My granddaughter Lycaena, whom you knew as a little girl, is now a Doctor in Natural Sciences. She speaks English, French, Spanish and a little Greek. She also speaks American which she learned while playing with the children in the magnificent Quaker's College." (Friends' school.)

I met Mr. Querci in Florence, Italy, many years ago, and established a connection that lasted till 1936, during which time he sent me one of the best collections of European butterflies in this country. After his return to Italy he collected extensively in Spain and Portugal, and wrote up the Butterflies of the Peninsula.

The last I heard from him was in 1936 when Lycaena, now a tall girl, sent me her photograph, with an alpinestock, collecting in the mountains of Salonica, Greece. That they have been out of touch for a long time is indicated by their inquiry as to my old friends, Mengel, Schaus and Benjamin, all passed on.

Some account of his work was published by Jean Gunder in the Ent. News, Vol. 41, p. 292, 1930, and on pl. 28, his interesting family, in Cuba. His address now is Via Aterno 15, Roma, Italia.

Our mutual friends will be delighted to learn that this interesting family has survived. R. C. WILLLIAMS, JR.

Current Entomological Literature

COMPILED BY THE EDITORIAL STAFF.

Under the above head it is intended to note papers received at the Academy of Natural Sciences of Philadelphia and the University of Pennsylvania, pertaining to the Entomology of the Americas (North and South), including Arachnida and Myriopoda. Articles irrelevant to American entomology will not be noted; but contributions to anatomy, physiology and embryology of insects, however, whether relating to American or exotic species will be recorded.

This list gives references of the current or preceding year unless otherwise noted. Continued papers, with few exceptions, are recorded only at their first installment.

For records of Economic Literature, see the Experiment Station Record, Office of Experiment Stations, Washington. Also Review of Applied Entomology, Series A, London. For records of papers on Medical Entomology, see Review of Applied Entomology, Series B.

NOTE: The figures within brackets [ ] refer to the journal in which the paper appeared, as numbered in the List of Journals given at the end of the literature. The number of the volume, and in some cases, the part, heft, &c. is followed by a colon (:). References to papers containing new forms or names not so stated in titles are followed by (*); if containing keys are followed by (k); papers pertaining exclusively to Neotropical species, and not so indicated in the title, have the symbol (S).

Papers published in ENTOMOLOGICAL NEWS are not listed.

GENERAL—Anon.—Random notes on winter collecting. [Turtox News] 22: 159–60. **Chapin, E. A. et al.**—Insects and mites. Biological results of the last cruise of the Carnegie. [Sci. Res. Cruise VII of Carnegie] Biol. 4: 91–92. (Some Diptera by Aldrich & Stone) (S). **Falkenström, Gustaf.**—(Obituary.) [4] 76: 211. **Fletcher, F. C.**—Some different kinds of insect collections. [118] 18: 14–15. **Garman, Harrison.** 1856–1944.—(Obituary.) [12] 37: 720–21, photo. **Grensted, L. W.**—Formation and gender of generic names. [8] 80: 229–333. **Hemming, F.**—Recent and forthcoming publications of the International Commission on Zoological Nomenclature. [93] 113 B: 176–77. **William Williams Henderson.** 1879–1944.—(Obituary.) [Farm and Home Sci. Utah Ag. Ex. Sta.] 5 (4): 4, 6. **Jordan, K.**—The status and functions of the International Commission on Zoological Nomenclature and the present state of its work. [6] 52: 385–87. **Linsley, E. G.**—Natural sources, habitats and reservoirs of insects associated with stored food products. [Hilgardia] 16: 187–224. **Popham, E. J.**—Study of the changes in an aquatic insect population, using minnows as predators. [93] 114 B: 74–81. **Rau, P.**—Entomological trivialities and personalities. [19] 39: 119–21. **Sanderson, E. Dwight.**—(Obituary.) [12] 37: 721. **Stern, C.**—Study of race. (Rev. of contributions to genetics, etc. of Drosophila

pseudoobscura. [Jour. Heredity] 35: 314–16. **Torre-Bueno, J. R.**—Why not eat insects. [19] 39: 122–31. Why amateurs. [19] 39: 137. **Townsend, Charles H. T.**—Obituary note. [105] 15: 236–37, port. **Walkden & Wilbur.**—Insects and other arthropods collected in pasture grasses, waste lands and forage crops, Manhattan, Kans. [103] 17: 128–43.

ANATOMY, PHYSIOLOGY, MEDICAL—Arrow, G. J.—Reduction of segmentation in the Coleoptera. [107] 19: 107–8. **Brand, Th. von.**—Occurrence of anaerobiosis among invertebrates. A review. [Biodynamica] 4 (92): 185–328. **Bridges & Brehme.**—Mutants of Drosophila melanogaster. [Carnegie Inst. Wash. Pub.] no. 552, 252 pp. ill. **Carlson, Cassil & Yothers.**—Ether-extract content of codling moth cocoons. [12] 37: 711. **Crombie, A. C.**—Effect of crowding upon the natality of grain-infesting insects. [93] 113 B: 77–98. **Davidson, J.**—On the growth of insect populations with successive generations. [Australian J. Exp. Biol. & Med. Sci.] 22: 95–103, ill. **Dobzhansky & Epling.**—Contributions to the genetics, taxonomy, and ecology of Drosophila pseudoobscura and its relatives. [Carnegie Inst. Wash. Pub.] no. 554, 183 pp. **Fennah, R. G.**—Morphology of the tegimina and wings of Fulgoridae. [10] 46: 185–99, ill. **Flanders, S. E.**—Olfactory responses of parasitic hymenoptera in relation to their mass production. [12] 37: 711–12. **Ford, E. B.**—Studies on the chemistry of pigments in the Lepidoptera, with reference to their bearing on systematics. 3. Red pigments of the Papilionidae. [107] 19: 92–106. **Henson, H.**—Development of the malpighian tubules of Blatta orientalis (Orth.). [107] 19: 73–91, ill. **Keilin, D.**—Respiratory systems and respiratory adaptations in larvae and pupae of Diptera. [116] 36: 1–66, ill. **Richards, A. G., Jr.**—The structure of living insect nerves and nerve sheaths as deduced from the optical properties. [6] 52: 285–310, ill. **Roy & Ghosh.**—Studies on the population of head-lice, Pediculus humanus var. capitis. [116] 36: 69–72. **Snodgrass, R. E.**—Feeding apparatus of biting and sucking insects affecting man and animals. [60] 104 (7): 113 pp., ill. **Xavier da Cunhia, A.**—O desenvolvimento das glandulas e sexualis na Ephestia kuehniella. [Mem. e Estud. Mus. Zool. Univ. Coimbra] 131: 29 pp., ill.

ARACHNIDA AND MYRIOPODA—Cooley, R. A.—Ixodes ozarkus n. sp. and Ornithodoros aquilae n. sp. with notes on O. talaje and O. kelleyi. [17] 30: 287–94, ill. **Hoffmann, A.**—Periglischrus vargasi n. sp. (Acarina: Parasitid). [56] 5: 91–96, ill. **Robinson, G. G.**—More cases of abnormal development in the argasid tick Ornithodorus moubata. [116] 36: 95–97, ill. **Baker & Balock.**—Mites of the family Bdellidae. [10] 46: 176–82, ill. (*). **Turk, F. A.**—Myriapoda (Chilopoda and Diplopoda) from Cornwall, with notes and descriptions of forms new to the British fauna. [75] (11) 71: 532–51 (*). **Lunn, H. F.**—Observations on the Sarcoptes of man. [116] 36: 67–68, ill.

SMALLER ORDERS AND ORTHOPTERA—Carriker, M. A.—Studies in Neotropical Mallophaga III. [50] 95: 81–233, ill. (*). **Crawford, J. C.**—New Sericothrips from Brazil. [10] 46: 200–01. **Rau, P.**—Note on the period of incubation of the eggs of the cockroach Blatella germanica. [4] 76: 212. **Roy & Ghosh.**—(See under medical.) **Soukup, J.**—Los tisanopteros Peruanos. [66] 8: 57–66. **Tuthill, L. D.**—Contributions to the knowledge of the Psyllidae of Mexico. [103] 17: 143–59, cont. (*). **Whitehead & Miner.**—Biology and control of the camel cricket. [12] 37: 573–81, ill. **Wygodzinsky, P.**—Contribuicao ao conhecimento da familia Machilidae do Mexico, do Brasil e Argentina (Thysanura). [105] 15: 54–96 (*).

HEMIPTERA—Caldwell, J. S.—Psyllidae from tropical and semitropical America. [6] 52: 335–41, ill. (*). Tribe Cenchreini with special reference to the Cenchrea complex. [19] 39: 99–110, ill. (*). Pintalia with special reference to Mexico (Cixiid). [55] 20: 154–60, ill. (*). **Carvalho, J. C. M.**—Mirideos neotropicais: Revisao do gen. Derophthalma e descr. do um gen. n. fauna chilena. Sobre os gen. Jobertus, Parachius e Pliniella. [105] 15: 144–53, ill.; 162–71. **Carvalho & Drake.**—Knightonia n. n. for Knightiella (Mirid). [105] 15: 239. **De Long, D. M.**—Four n. sps. of Cloanthanus and Tumeus from Mexico and Brazil (Cicadellid). [55] 20: 129–31. **Essig, E. O.**—New aphid on guayule and notes on other sps. of Cerosipha. [Hilgardia] 16: 177–84. **Fennah, R. G.**—(See under anatomy.) **Hawboldt, L. S.**—History of spread of the beech scale, Cryptococcus bagi, an insect introduced into the maritime provinces. [Academy Nat. Bull. Nat. Hist. Soc. N. Brunswick] 137–46. **Metcalf & Bruner.**—Cercopidae of Cuba.

[80] 109–28, ill. (*). **Oman & Beamer.**—Some n. sps. of Cuerna (Cicadellid). [103] 17: 121–28. **Smith, R. H.**—Bionomics and control of the nigra scale, Saissetia nigra. [Hilgardia] 16: 225–88. **Holedo Piza, S. de, Jr.**—Duas novas esp. de ploiariideos brasilleiros. [105] 15: 135–38, ill. **Torre-Bueno, J. R.**—Comment on Solabea Bergroth. [19] 39: 114–16 (k). New records of Oncopeltus. [19] 39: 135–36 (*). **Wygodzinsky, P.**—Notas sobre a biologia e o desenvolvimento de Macrocephalus notatus (Phymatid). [105] 15: 139–43, ill.

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